This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

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Hemisphere GPS Precision GPS Applications

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Hemisphere GPS products may be covered by one or more of the following U.S. Patents:

6,111,549	6,397,147	6,469,663	6,501,346	6,539,303
6,549,091	6,631,916	6,711,501	6,744,404	6,865,465
6,876,920	7,142,956	7,162,348	7,277,792	7,292,185
7,292,186	7,373,231	7,400,956	7,400,294	7,388,539
7,429,952	7,437,230	7,460,942		

Other U.S. and foreign patents pending.

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Overview

This quick reference guide provides information to get you up and running quickly with your MV102 GPS Compass. For more detailed information on using the MV102 refer to the MV102 GPS Compass User Guide.

This guide consists of the following sections:

- "Parts List" below describes the parts in your MV102 GPS Compass kit
- "Additional Documentation" below provides information for additional MV102 documentation
- "Installation Considerations" on page 2 contains recommendations for where to place your MV102, dimensions of the unit, VHF interference, and mounting options
- "Mounting Orientation" on page 4 describes parallel and perpendicular orientations
- "Alignment" on page 5 describes how to align the MV102
- "Connecting the MV102 to External Devices" on page 12 provides information on the included power/data cable and how to connect to serial ports
- "Configuration" on page 14 lists basic configuration information
- "Supplemental Sensors" on page 14 describes the purpose of and calibration procedures for the sensors
- "Common Commands and Messages" on page 15 lists commands and messages common to MV102 (for more information on commands and messages see the GPS Technical Reference from www.hemispheregps.com)

Parts List

In addition to this Quick Reference Guide (which is included in the MV102 kit), installing the MV102 GPS Compass requires the following:

- MV102 GPS Compass
- Kit (accessory item) containing the following:
  - Power/data cable (15 m)
  - Clamp
  - Screw
  - Washer
- Serial-to-NMEA 2000 adapter, PN 710-0104-000#

Additional Documentation

For more in-depth information on the MV102 GPS Compass you can download the MV102 User Guide.

Installation Considerations

Refer to the MV102 GPS Compass User Guide for more detailed installation instructions.

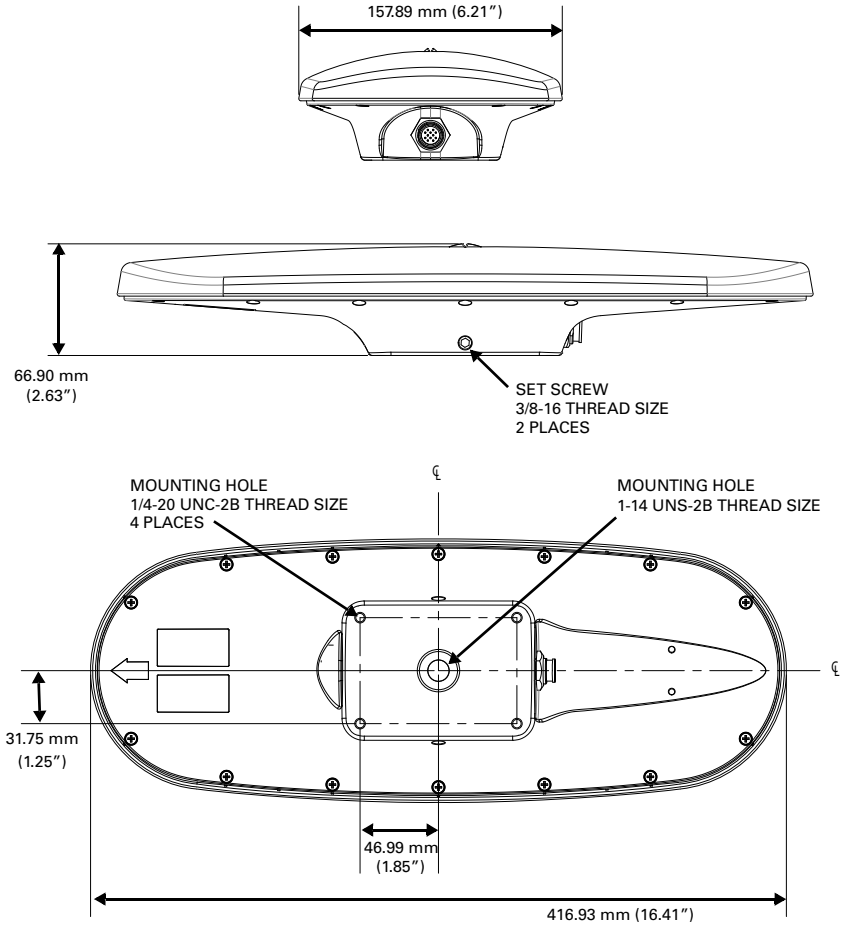
Location

Proper location is important to obtain a high-precision GPS reading. Choose an installation location using either the pole or fixed mount where the MV102:

- Has a clear view of the sky
- Is away from other electronics and antennas
- Has enough cable to reach a power source
- Is on a level plane

Dimensions

The following drawing illustrates the physical dimensions of the MV102.

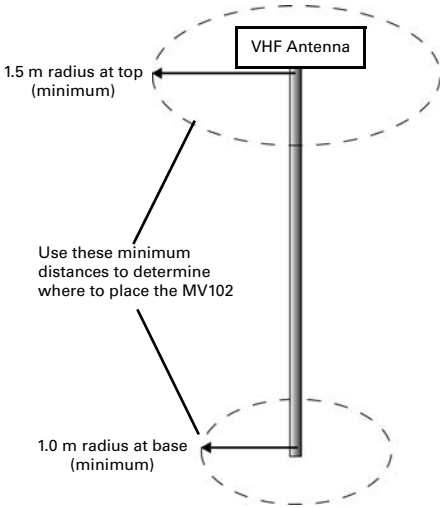


VHF Interference

VHF interference from such devices as cellular phones and radio transmitters may interfere with GPS operation. For example, if installing the MV102 near marine radios consider the folowing:

- VHF marine radio working frequencies (Channels 1 to 28 and 84 to 88) range from 156.05 to 157.40 MHz. The L1 GPS working center frequency is 1575.42 MHz. The bandwidth is +/- 2MHz to +/- 10 MHz, which is dependent on the GPS antenna and receiver design.
- VHF marine radios emit strong harmonics. The 10th harmonic of VHF radio, in some channels, falls into the GPS working frequency band, which may cause the SNR of GPS to degrade significantly.
- The radiated harmonic signal strength of different brands/ models varies.
- Follow VHF radio manufacturers' recommendations on how to mount their radios and what devices to keep a safe distance away.
- Handheld 5W VHF radios may not provide suitable filtering and may interfere with the MV102's operation if too close.

Before installing the MV102 use the following diagram to ensure there are no nearby devices that my cause VHF interference.



Mounting Options

***Hemisphere GPS does not provide the mounting hardware.**

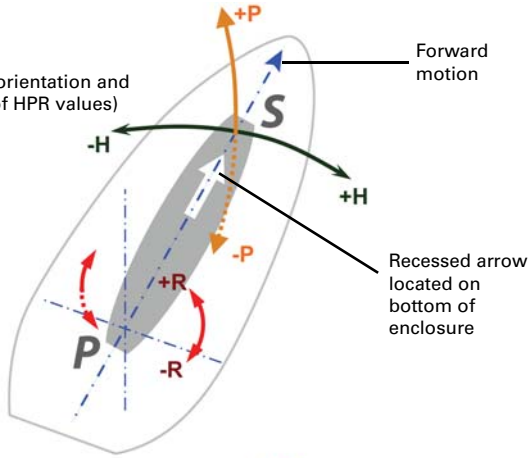
The MV102 allows for two different mounting options: flush mount and pole mount.

- Flush mount - The bottom of the MV102 contains four holes for flush mounting the unit to a flat surface (see "Dimensions" on page 2).
- Pole mount - The bottom of the MV102 contains a mounting hole (1" thread, 0.9" depth) for easy pole mounting. Hand tighten (do not overtighten). The set screws on the long sides of the base (see diagram above) allow you to secure the MV102 in place (3/16" Allen wrench not included).

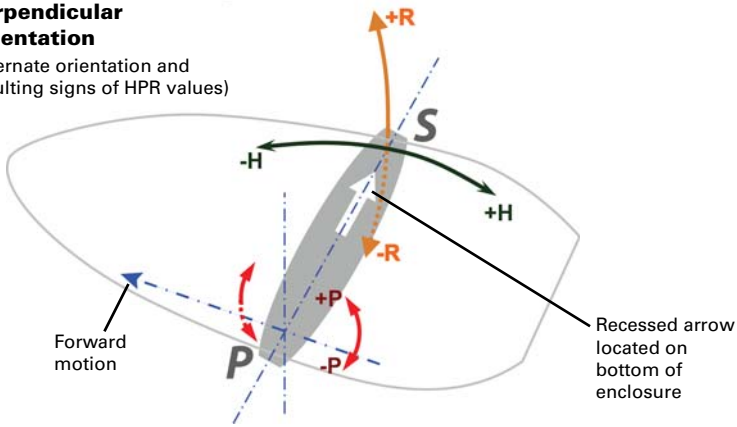
Mounting Orientation

The MV102 outputs heading, pitch, and roll readings regardless of the orientation of the antennas. However, the relation of the antennas to the boat's axis determines whether you will need to enter a heading, pitch, or roll bias. The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

Parallel Orientation
(recommended orientation and resulting signs of HPR values)



Perpendicular Orientation
(alternate orientation and resulting signs of HPR values)



Alignment

The top of the MV102 enclosure incorporates sight design features to help you align the enclosure with respect to an important feature on your vessel.

To use the sights, center the small post on the opposite side of the enclosure from you, within the channel made in the medallion located in the center of the enclosure top as shown in Figure 1 and Figure 2. Alignment accuracy when looking through the long site (Figure 1) is approximately +/- 1°, while alignment through the short site (Figure 2) is approximately +/- 2.5°.

Figure 1: Long site alignment

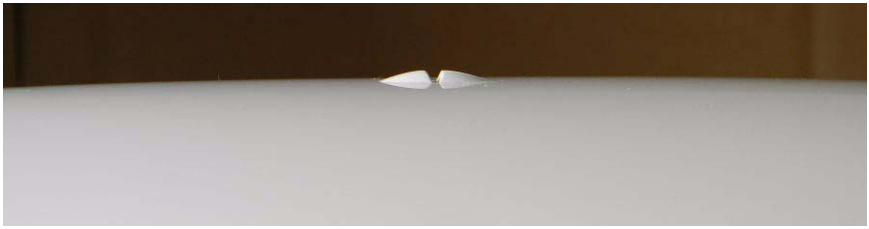


Figure 2: Short sight alignment

Ports

The MV102 offers either serial port or NMEA 2000 port functionality.

Serial Ports

The MV102 offers position and heading data via two full-duplex (bi-directional) RS-232 serial ports. Besides outputting data, these ports are used for firmware upgrades.

Selecting Baud Rates and Message Types

When selecting your baud rate and message types, use the following calculation to determine your baud rate for your required data throughput.

Messages * Message output rate * Message length (bytes) * bits in byte
Ex: 5 * 20Hz * 40 bytes * 10 = 40,000 bits/sec

For information on message output rates refer to GPS Technical Reference available from the Hemisphere GPS website at www.hemispheregps.com.

Configuring the Ports

You may configure Port A or Port C of the GPS receiver to output any combination of data that you want. Port A can have a different configuration from Port C in terms of data message output, data rates, and the baud rate of the port. This allows you to configure the ports independently based upon your needs.

The CAN processor that controls Port C is by default programmed into NMEA 2000 mode. You must configure Port C as a serial port to use the MV102 with two serial ports. Port A is always a serial port. To configure Port C as a serial port refer to Table 1 on page 7.

For example, if you want one generalized port and one heading-only port, you can configure the ports as follows:

- Port A to have GPGGA, GPVTG, GPGSV, GPZDA, and GPHDT all output at 1 Hz over a 9600 baud rate
- Port C to have GPHDT and GPROT output at their maximum rate of 20 Hz over a 19200 baud rate

A personal computer (PC) typically uses a DB9-male connector for RS-232 serial port communications.

Note: For successful communications use the 8-N-1 protocol and set the baud rate of the MV102's serial ports to match that of the devices to which they are connected. Flow control is not supported.

Recommendations for Connecting to Other Devices

When interfacing to other devices, ensure the transmit data output from the MV102 is connected to the data input of the other device. The signal grounds must also be connected.

There is likely little reason to connect the receive data input of the MV102 to another device unless it is able to send configuration commands to the MV102. Since the MV102 uses proprietary NMEA 0183 commands for control over its configuration, the vast majority of electronics will not be able to configure its settings unless the other device has a terminal setting where you can manually issue commands.

NMEA 2000 Port

By default, Port C is configured as a NMEA 2000 port with the default baud rate of 57600.

To use MV102 for NMEA 2000 you have to connect the included serial-to-NMEA 2000 adapter (P/N 710-0104-000#) to the unit. Figure 3 shows the adapter. Insert the 12-pin connector of the adapter into the male end of the 12-pin connector on the MV102 by aligning the keys. You can then attach the adapter to the unit using the supplied screws (machine, 8-32, ½", PPHC, SS) and washer (washer, flat, #8, SS). The 5-pin male Micro-C connector connects to your NMEA 2000 drop cable.

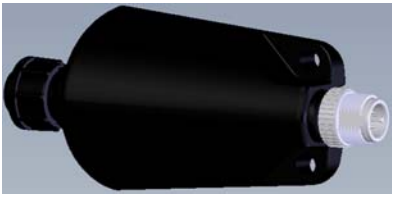


Figure 3: Serial-to-NMEA 2000 adapter

Table 1 lists the commands used to configure Port C back to serial or NMEA 2000 when necessary. You can only send these commands using Port A.

Table 1: Commands for changing Port C (must be sent through Port A)

Command	Reply	Description
$JRELAY,PORTC,$JSERIALMODE	$>JSERIALMODE,ENABLED $>resetting	Switch Port C to serial
$JRELAY,PORTC,$JN2KMODE	$>JN2KMODE,ENABLED $>resetting	Switch Port C to NMEA 2000

Table 2 shows the requested PGNs with the MV102 in NMEA 2000 mode.

Table 2: Received messages based on a request

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
059392	ISO Acknowledgement Used to acknowledge the status of certain requests addressed to a specific ECU.	B	On Request	On Request
059904	ISO Request Request the transmission of a specific PGN, addressed or broadcast.	B	On Request	On Request
060928	ISO Address Claim Used to identify to other ECUs the address claimed by an ECU.	B	On Request	On Request

Table 2: Received messages based on a request (*continued)*

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
126996	Product Information NMEA 2000 database version supported, manufacturer's product code, NMEA 2000 certification level, Load Equivalency number, and other product-specific information.	B	On Request	On Request
126464	Receive/Transmit PGNs group function The Transmit / Receive PGN List Group type of function is defined by first field. The message will be a Transmit or Receive PGN List group function.	B	On Request	On Request
129538	GNSS Control Status GNSS common satellite receiver parameter status.	B	On Request	On Request
129545	GNSS RAIM Output Used to provide the output from a GNSS receiver's Receiver Autonomous Integrity Monitoring (RAIM) process. The Integrity field value is based on the parameters set in PGN 129546 GNSS RAIM Settings.	B	On Request	On Request
129546	GNSS RAIM Settings Used to report the control parameters for a GNSS Receiver Autonomous Integrity Monitoring (RAIM) process.	B	On Request	On Request

Table 3 shows the transmitted PGNs with their default update rate with the MV102 in NMEA 2000 mode.

Table 3: Transmitted messages

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
126992	System Time The purpose of this PGN is twofold: To provide a regular transmission of UTC time and date. To provide synchronism for measurement data.	B	1000	1

Table 3: Transmitted messages (*continued*)

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
127250	Vessel Heading Heading sensor value with a flag for True or Magnetic. If the sensor value is Magnetic, the deviation field can be used to produce a Magnetic heading, and the variation field can be used to correct the Magnetic heading to produce a True heading.	B	100	10
127251	Rate of Turn Rate of change of the Heading.	B	100	10
127257	Attitude Provides a single transmission that describes the position of a vessel relative to both horizontal and vertical planes. This would typically be used for vessel stabilization, vessel control and onboard platform stabilization.	B	1000	1
127258	Magnetic Variation Message for transmitting variation. The message contains a sequence number to allow synchronization of other messages such as Heading or Course over Ground. The quality of service and age of service are provided to enable recipients to determine an appropriate level of service if multiple transmissions exist.		1000	1
128259	Speed Provides a single transmission that describes the motion of a vessel.	B	1000	1
129025	Position, Rapid Update Provides latitude and longitude referenced to WGS84. Being defined as single frame message, as opposed to other PGNs that include latitude and longitude and are defined as fast or multi-packet, this PGN lends itself to being transmitted more frequently without using up excessive bandwidth on the bus for the benefit of receiving equipment that may require rapid position updates.	B	100	10
129026	COG & SOG, Rapid Update Single frame PGN that provides Course Over Ground (COG) and Speed Over Ground (SOG).	B	250	4

Table 3: Transmitted messages (*continued*)

PG No. (PGN)	Description	Level	Default Update Rate (msec)	Freq (Hz)
129027	Position Delta, High Precision Rapid Update The "Position Delta, High Precision Rapid Update" Parameter Group is intended for applications where very high precision and very fast update rates are needed for position data. This PGN can provide delta position changes down to 1 mm with a delta time period accurate to 5 msec.	B	100	10
129028	Altitude Delta, High Precision Rapid Update The "Altitude Delta, High Precision Rapid Update" Parameter Group is intended for applications where very high precision and very fast update rates are needed for altitude and course over ground data. This PG can provide delta altitude changes down to 1 millimeter, a change in direction as small as 0.0057°, and with a delta time period accurate to 5 msec.	B	100	10
129029	GNSS Position Data Conveys a comprehensive set of Global Navigation Satellite System (GNSS) parameters, including position information.	B	1000	1
129033	Time & Date Single transmission that provides UTC time, UTC Date, and Local Offset.	B	1000	1
129539	GNSS DOPs Provides a single transmission containing GNSS status and dilution of precision components (DOP) that indicate the contribution of satellite geometry to the overall positioning error. There are three DOP parameters reported: horizontal (HDOP), Vertical (VDOP), and time (TDOP).	B	1000	1
129540	GNSS Sats in View GNSS information on current satellites in view tagged by sequence ID. Information includes PRN, elevation, azimuth, SNR, defines the number of satellites; defines the satellite number and the information.	B	1000	1

Powering the MV102

Power Considerations

For best performance use a clean and continuous power supply. The MV102 power supply features reverse polarity protection but will not operate with reverse polarity.

Additional power specifications include:

- Input voltage: 6 to 36 VDC
- Power consumption: ~ 3 W nominal
- Current consumption: 320 mA @ 9 VDC
  240 mA @ 12 VDC
  180 mA @ 16 VDC
- Power isolation: Isolated to enclosure

Connecting to a Power Source

Note: This section refers to powering the unit via serial connection. To power the unit via NMEA 2000 connection, following the standard procedure for powering up via NMEA 2000.

Before you power up the MV102 you must terminate the wires of the power cable as required. There are a variety of power connectors and terminals on the market from which to choose, depending on your specific requirements.

⚠WARNING: Do not apply a voltage higher than 36 VDC. This will damage the receiver and void the warranty.

To interface the MV102 power cable to the power source:

- Connect the red wire of the cable's power input to DC positive (+)
- Connect the black wire of the cable's power input to DC negative (-)

The MV102's smart antenna will start when an acceptable voltage is applied to the power leads of the extension cable.

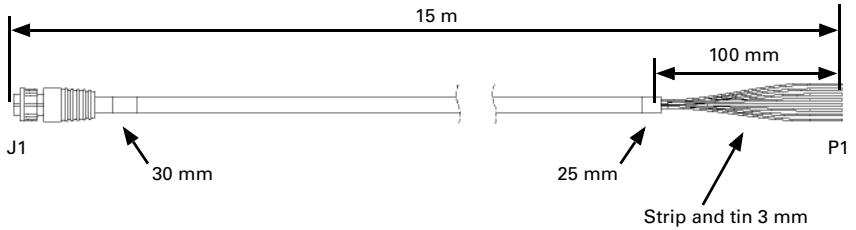
Electrical Isolation

The MV102's power supply is isolated from the communication lines and the PC-ABS plastic enclosure isolates the electronics mechanically from the vessel (addressing the issue of vessel hull electrolysis).

Connecting the MV102 to External Devices

Power/Data Cable

The MV102 uses a single 15 m (49 ft) cable for power and data input/output.



The receiver end of the cable is terminated with an environmentally sealed 12-pin connection; the opposite end is unterminated and requires field stripping and tinning.

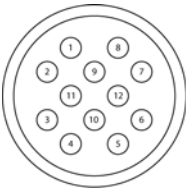


Table 4 shows the cable's pinout specifications.

Table 4: Power/data cable pinout

Pin	Function	Wire Color
1	Port C, RS-232 female DB9 pin 2, device out	White
2	Port C, RS-232 female DB9 pin 3, device in	Green
3	N/C	N/C
4	N/C	N/C
5	Power input	Red
6	N/C	N/C
7	Signal ground	Yellow
8	Port A, RS-232 female DB9 pin 3, device in	Brown
9	Port A, RS-232 female DB9 pin 2, device out	Blue
10	Power ground	Black
11	CH_GND	Drain
12	N/C	N/C

Default Parameters

Table 5 and Table 6 provide details on the default port settings, available baud rates, differential age, elevation mask, and default differential mode. Use the $JSAVE command to save changes you make to the MV102's configuration for the changes to be present in subsequent power cycles.

Table 5: Default port settings

Port	Baud Rate	NMEA Messages	Update Rate
Port A (RS-232)	19200	GPGGA, GPVTG, GPGSV, GPZDA, GPHDT, GPROT	1 Hz
Port C (RS-232)	19200	GPGGA, GPVTG, GPGSV, GPZDA, GPHDT, GPROT	1 Hz
Power RED (+), BLK (-)	6 - 36 VDC		
Note: The default update rate for NMEA 0183 messages is 1 Hz. 10 Hz is the standard maximum rate, but you can purchase a subscription to upgrade the output rate to 20 Hz.			

Table 6: Additional default settings

Parameter	Specification
Max DGPS age (correction age)	2700 seconds
Elevation mask	5°
Differential mode	SBAS (WAAS/EGNOS)

Configuration

Use a terminal program or PocketMax3 (available at www.hemispheregps.com) to connect to a serial port for additional configuration requirements. Use default baud rate of 19200 bps and 8-N-1 protocol.

- Change baud rate of either port to match that of the external equipment to which the MV102 is connected. After changing the baud rate, you must close the terminal program and reconnect at the speed selected.
- Configure NMEA messages to be output on the appropriate port.
- Select differential source.
- Input heading bias (-180° to +180°) to compensate for any offset from the centerline.
- Input bias for tilt (-15° to +15°) to compensate for any offset from horizontal.
- Enable/disable supplementary sensors (default is GYROID and TILTAID on).
- Use the $JSAVE command to save the configuration changes when finished.

Supplemental Sensors

A pair of tilt sensors and a gyro are integrated in the MV102. The user can turn either the tilt sensors or the gyro on or off. However, the system's performance is optimized with both the tilt sensors and the gyro on.

Sensor	Purpose	Calibration Procedure
Gyro aid	Smooth rate of turn: Provides alternate source of heading for up to 3 min when GPS lock is lost Shortens heading reacquisition time	Will self-calibrate after several minutes To manually calibrate: 1. After heading is computed 2. Send $JATT,GYROAID,YES 3. Spin Vector for 1 min at less than 15°/sec 4. Leave unit stationary for 4 min **Note:** You do not need to recalibrate with standard use since the gyro selects the calibration.
Tilt aid	Smooths rate of heading Reduces startup and reacquisition times for obtaining heading	Precalibrated during manufacture To recalibrate: 1. Ensure Vector is level 2. Send $JATT,TILTCAL

Feature	Normal Operation	Coasting (no GPS)
Heading	GPS	Gyro
Heave	GPS	None
Pitch	GPS	Inertial sensor
Roll	Inertial sensor	Inertial sensor

Common Commands and Messages

Note: When selecting your baud rate and message types, use the following calculation to determine your baud rate for your required data throughput.

Messages * Message output rate * Message length (bytes) * bits in byte
Ex: 5 * 20Hz * 40 bytes * 10 = 40,000 bits/sec

For information on message output rates refer to GPS Technical Reference available from the Hemisphere GPS website at www.hemispheregps.com.

Table 7: Commands

Command	Description
$JAGE	Specify maximum DGPS (COAST) correction age (6 to 8100 seconds)
$JAPP	Query or specify receiver application firmware
$JASC	Specify ASCII messages to output to specific ports
$JBAUD	Specify RS-232, RS-422 (output) communication rate
$JBIN	Specify binary messages to output to specific ports
$JDIFF	Query or specify differential correction mode
$JGEO	Query or specify SBAS for current location and SBAS satellites
$JI	Query unit's serial number and firmware versions
$JOFF	Turn off all data messages
$JQUERY,GUIDE	Query accuracy suitability for navigation
$JRESET	Reset unit's configuration to firmware defaults. **$JRESET clears all parameters.** See the MV102 GPS Compass User Guide for more information.
$JSAVE	Save session's configuration changes

In Table 8 the Info Type value is one of the following: P = Position; V = Velocity, Time; H = Heading, Attitude; S = Sats, Stats, Quality

Table 8: NMEA 0183 and other messages

Message	Info Type	Description	IEC Approved Message
$GPDTM	P	Datum reference	Yes
$GPGGA	P	GPS position and fix data	Yes
$GPGLL	P	Geographic position - lat/long	Yes
$GPGNS	P	GNSS position and fix data	Yes

Table 8: NMEA 0183 and other messages (*continued)*

Message	Info Type	Description	IEC Approved Message
$GPGRS	S	GNSS range residual (RAIM)	Yes
$GPGSA	S	GNSS DOP and active satellites	Yes
$GPGST	S	GNSS pseudo range error statistics and position accuracy	Yes
$GPGSV	S	GNSS satellites in view	Yes
*$GPHDG	H	Provides magnetic deviation and variation for calculating magnetic or true heading	Yes
*$GPHDM	H	Magnetic heading (based on GPS-derived heading and magnetic declination)	No
*$GPHDT	H	GPS-derived true heading	Yes
$GPHEV	H	Heave value (in meters)	Yes
$GPRMC	P	Recommended minimum specific GNSS data	Yes
*$GPROT	H	GPS-derived rate of turn (ROT)	Yes
$GPRRE	S	Range residual and estimated position error message	Yes
$GPVTG	V	COG and ground speed	Yes
$GPZDA	V	Time and date	Yes
$PASHR	H	Time, heading, roll, and pitch data in one message	No
$PSAT,GBS	S	Satellite fault detection (RAIM)	Yes
$PSAT,HPR	H	Proprietary NMEA message that provides heading, pitch, roll, and time in single message	No
$PSAT,INTLT	H	Proprietary NMEA message that provides the pitch and roll measurements from the internal inclinometers (in degrees)	Yes
$RD1	S	SBAS diagnostic information	Yes
$TSS1	H	Heading, pitch, roll, and heave message in the commonly used TSS1 message format	No
* You can change the message header for the HDG, HDM, HDT, and ROT messages to either GP or HE using the $JATT,NMEAHE command. For more information refer to the Hemisphere GPS Technical Reference available at www.hemispheregps.com.			

Table 9: Binary messages

$JBIN Message	Description
1	GPS position
2	GPS DOPs
80	SBAS
93	SBAS ephemeris data
94	Ionosphere and UTC conversion parameters
95	Satellite ephemeris data
96	Code and carrier phase
97	Processor statistics
98	Satellites and almanac
99	GPS diagnostics

Table 10: Parameters specific to $JATT command

Parameter	Description	Query	Specify
COGTAU	Set/query COG time constant (0.0 to 3600.0 s)	X	X
CSEP	Query antenna separation	X	
EXACT	Enable/disable internal filter reliance on the entered antenna separation	X	X
FLIPBRD	Turn the flip feature on/off	X	X
GYROAID	Enable/disable gyro	X	X
HBIAS	Set/query heading bias (-180.0° to 180.0°)	X	X
HELP	Show the available commands for GPS heading operation and status	X	
HIGHMP	Set/query the High Multipath setting for use in poor GPS environments	X	X
HRTAU	Set/query ROT time constant (0.0 to 3600.0 s)	X	X
HTAU	Set/query heading time constant (0.0 to 3600.0 s)	X	X
LEVEL	Query or enable/disable level operation	X	X
MSEP	Manually set or query antenna separation	X	X
NEGTILT	Query or enable/disable negative tilt	X	X
NMEAHE	Query for the message headers or change the HDG, HDM, HDT, and ROT message headers between GP and HE	X	X
PBIAS	Set/query pitch/roll bias (-15.0° to 15.0°)	X	X
PTAU	Set/query pitch time constant (0.0 to 3600.0 s)	X	X
ROLL	Query or configure for roll or pitch GPS orientation	X	X
SEARCH	Force a new GPS heading search		X

Table 10: Parameters specific to $JATT command (*continued)*

Parameter	Description	Query	Specify
SPDTAU	Set/query speed time constant (0.0 to 3600.0 s)	X	X
SUMMARY	Display a summary of the current Crescent Vector settings	X	
TILTAID	Query or enable/disable accelerometer, pre-calibrated	X	X
TILTCAL	Calibrate accelerometers		X

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